Physics meeting, February 29, 2000

$gb \to H^+\bar{t}$; $H^+ \to \tau^+\nu$, $\bar{t} \to \bar{b}q\bar{q}$

R. Kinnunen

Production in PYTHIA through:

$$g\bar{b} \to H^+\bar{t}$$

Normalization of the cross section to the results from Moretti & Roy,

for m_{H+}=400 GeV, $\tan\beta$ = 40: $\sigma \sim 1$ pb

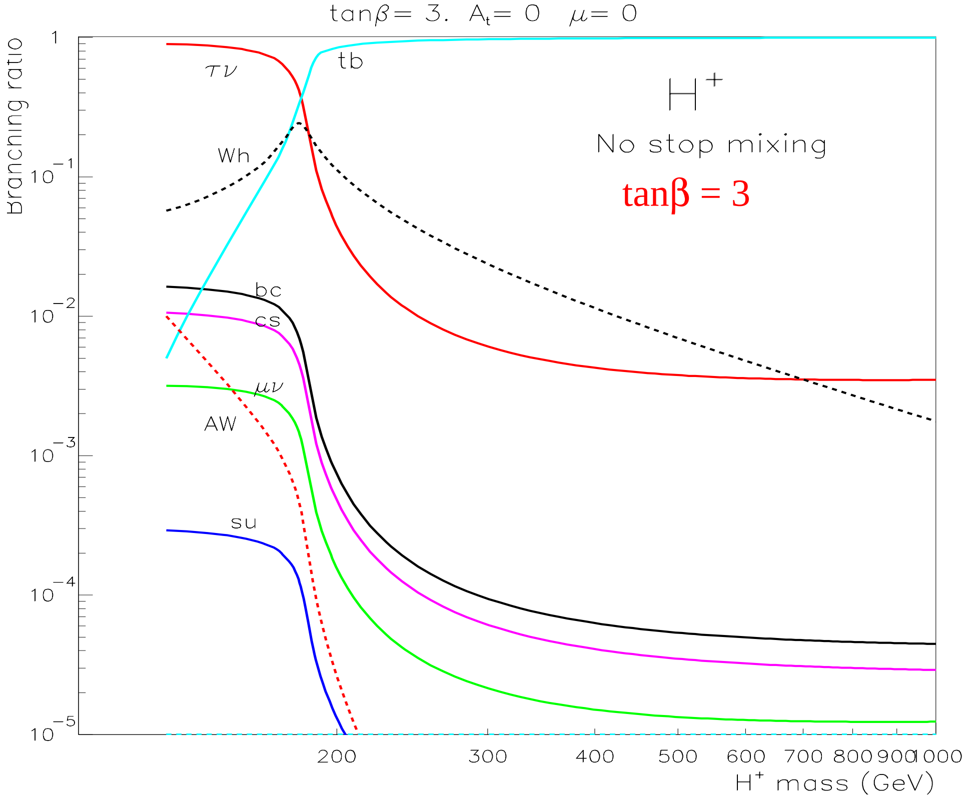
BR($H^+ \to \tau\nu$) from HDECAY:

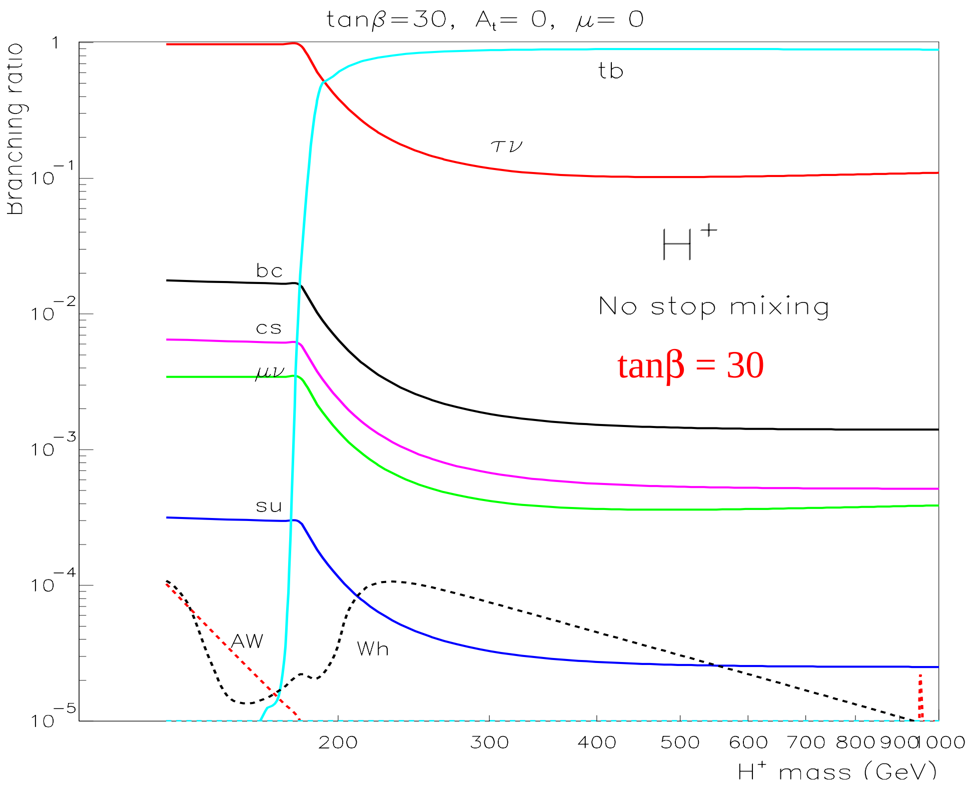
m_{H+}=407 GeV, $\tan\beta$ = 30 14.1%

m_{H+}=214 GeV, $\tan\beta$ = 15 36.8%

τ decay with polarization implemented to PYTHIA according to D. P. Roy

Branching ratios, H$^+$, no stop mixing





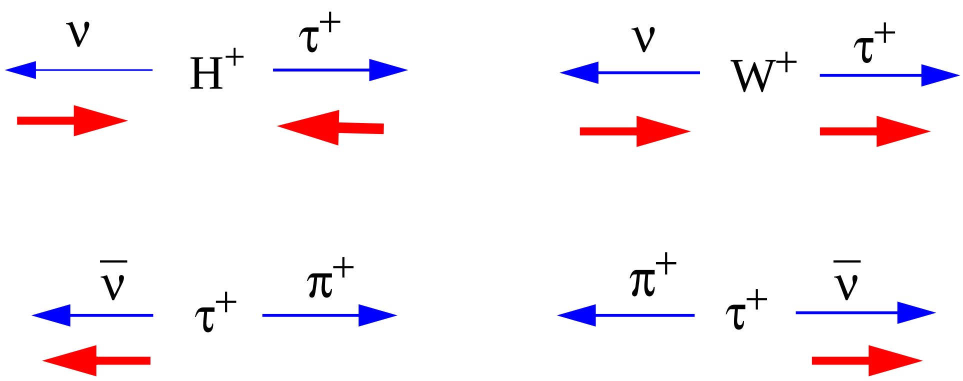
τ polarization in

$gb \to H^+\bar{t}$; $H^+ \to \tau^+\nu$, $\bar{t} \to \bar{b}q\bar{q}$

Main contributions to 1-prong decays

$\tau \to \pi^+\nu$	12.5%
$\tau \to \rho^+\nu \to \pi^+\pi^0\nu$	26%
$\tau \to a_1\nu \to \pi^+\pi^0\pi^0\nu$	7.5%

Effect of τ polarization in $H^\pm$ compared to $W^\pm$ decays:



harder pions from $\tau^+ \to \pi^+\nu$ and longitudinal

components of ρ and a_1 in $H^\pm$ than in $W^\pm$

τ decay with polarization included in PYTHIA using

the matrix elements and program of D.P. Roy

Trigger requirements for

$\mathbf{gb \to H^+\bar{t};\ \ H^+ \to \tau^+\nu,\ \ \bar{t} \to \bar{b}q\bar{q}}$

- Almost background-free signal in $m_T(\tau\nu)$ is expected only in the purely hadronic channel with W -> qq'

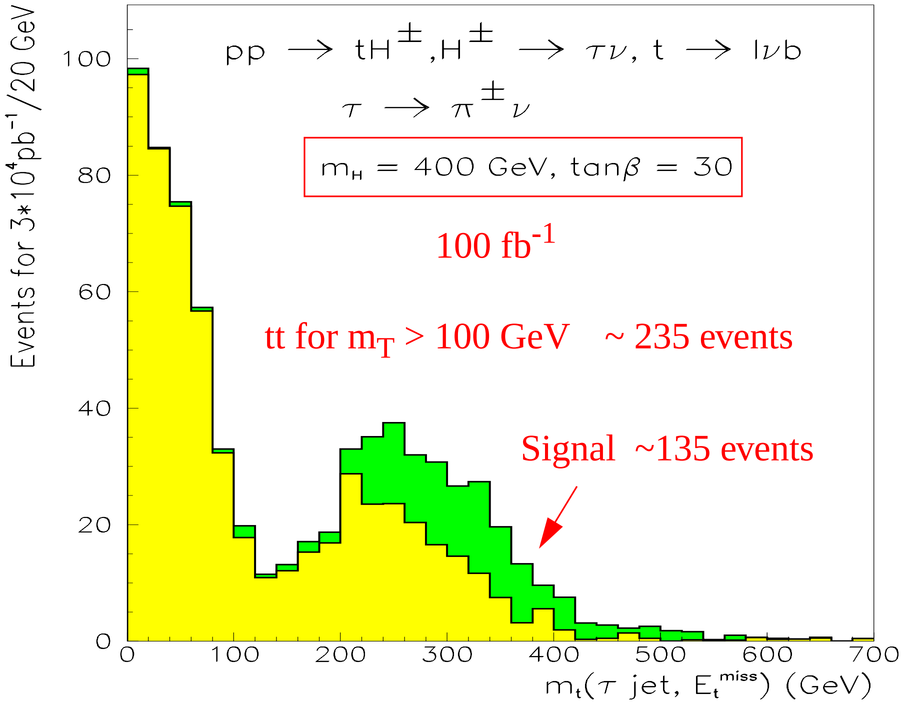
- τ polarization provides a large reduction of the $t\bar{t}$ background in the hadronic one prong decay channel $\tau \to \pi^+ + \nu$

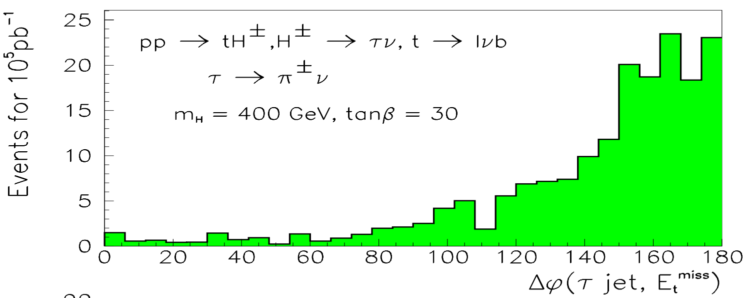
- a purely hadronic trigger with $n_{jet} < 4$ ($E_t^{jet} > 20$ GeV) including one hard τ jet ($E_t^{jet} > 100$ GeV) is needed

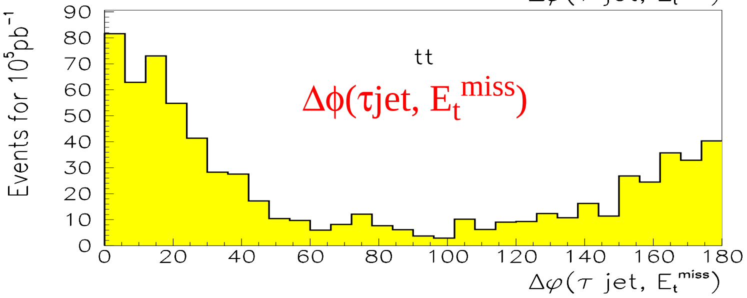
$pp \to \bar{t}H^+,\ H^+ \to \tau\nu,\quad \tau^+ \to \pi^+\nu$ with

$t \to$ lepton $+ \nu + b,\ p_t^{\,l} > 20$ GeV

Preliminary results for $m_T(\mathrm{lepton}, E_t^{miss})$ for 100 fb^{-1}







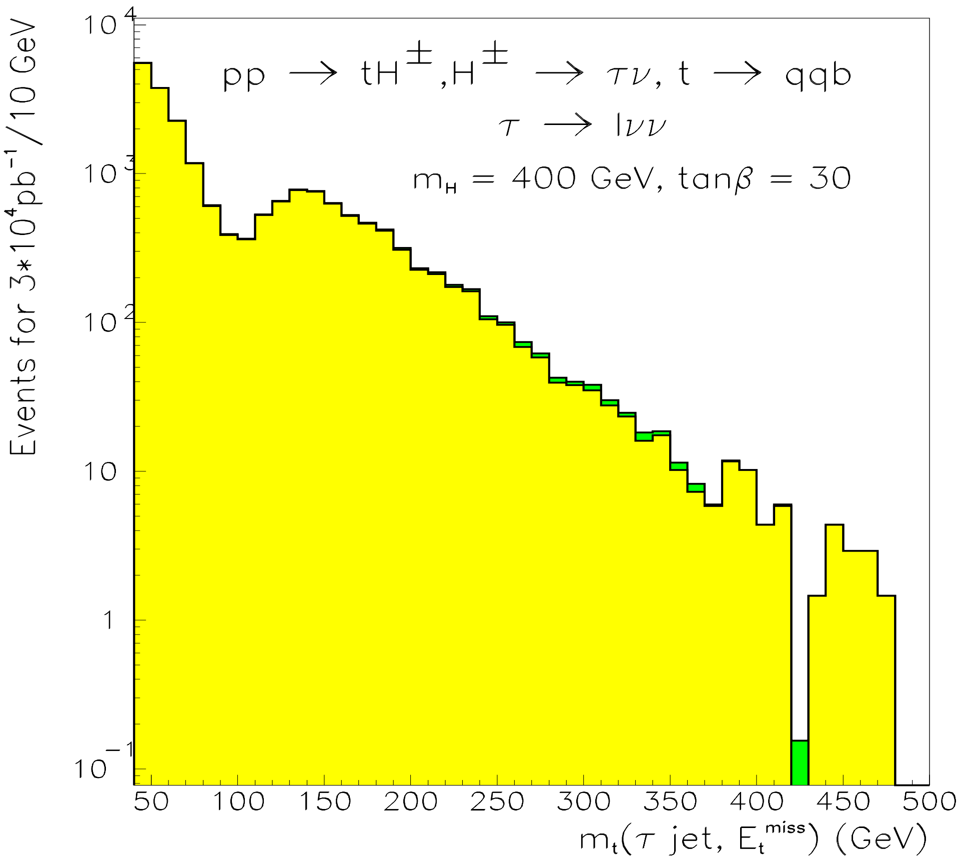
pp -> tH^+, H^+ -> τν, t -> qqb

using

τ -> lepton + ν_τ + ν_l , p_t^l > 30 GeV

τ polarization effects cannot be exploited

Preliminary results for m_T(lepton,E_t^{miss}) for 100 fb^{-1}

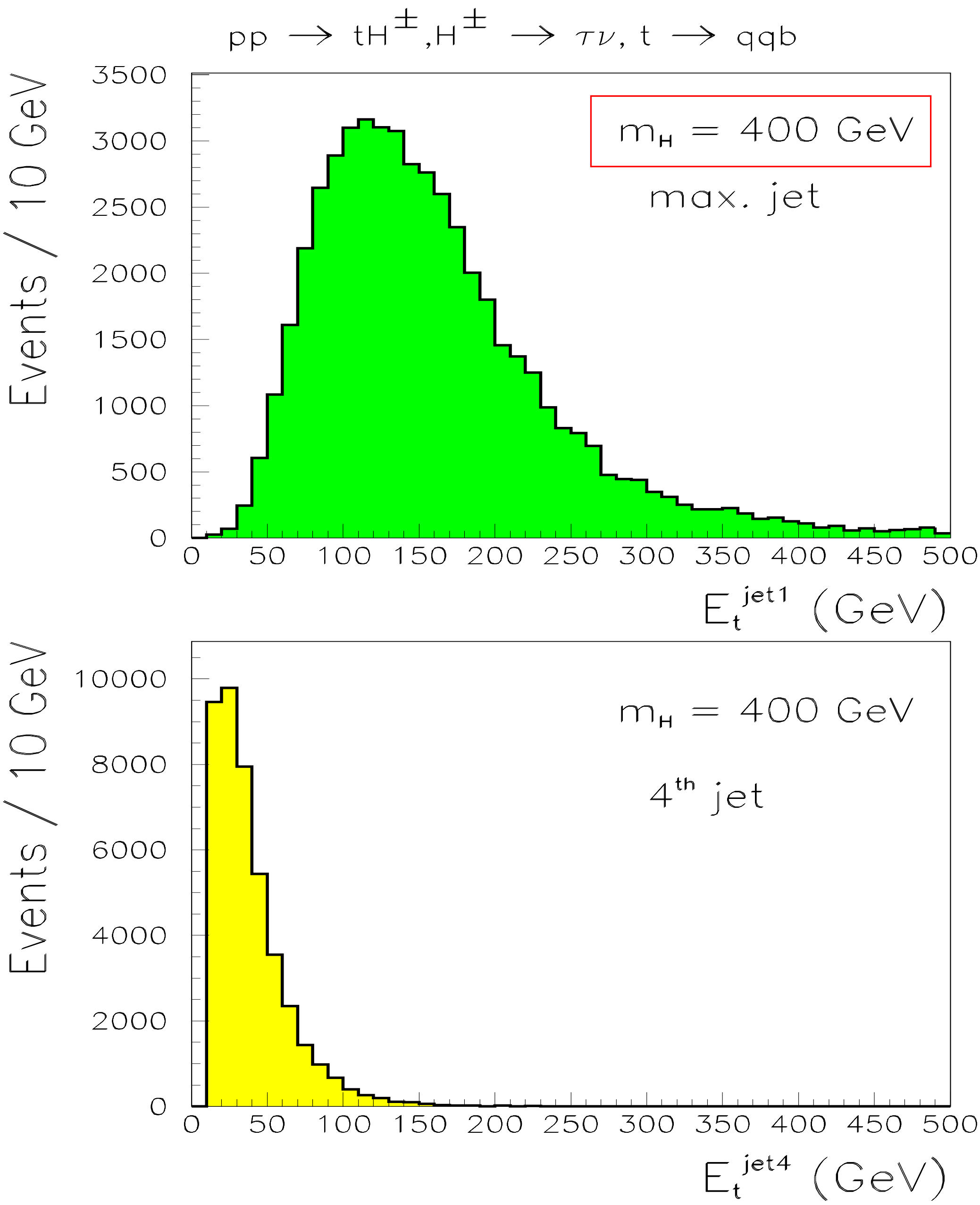


Events expected for m_T(lepton,E_t^{miss}) > 200 GeV:

H^+(m_H= 400 GeV, tanβ = 30)	58
$t\bar{t}$	1374

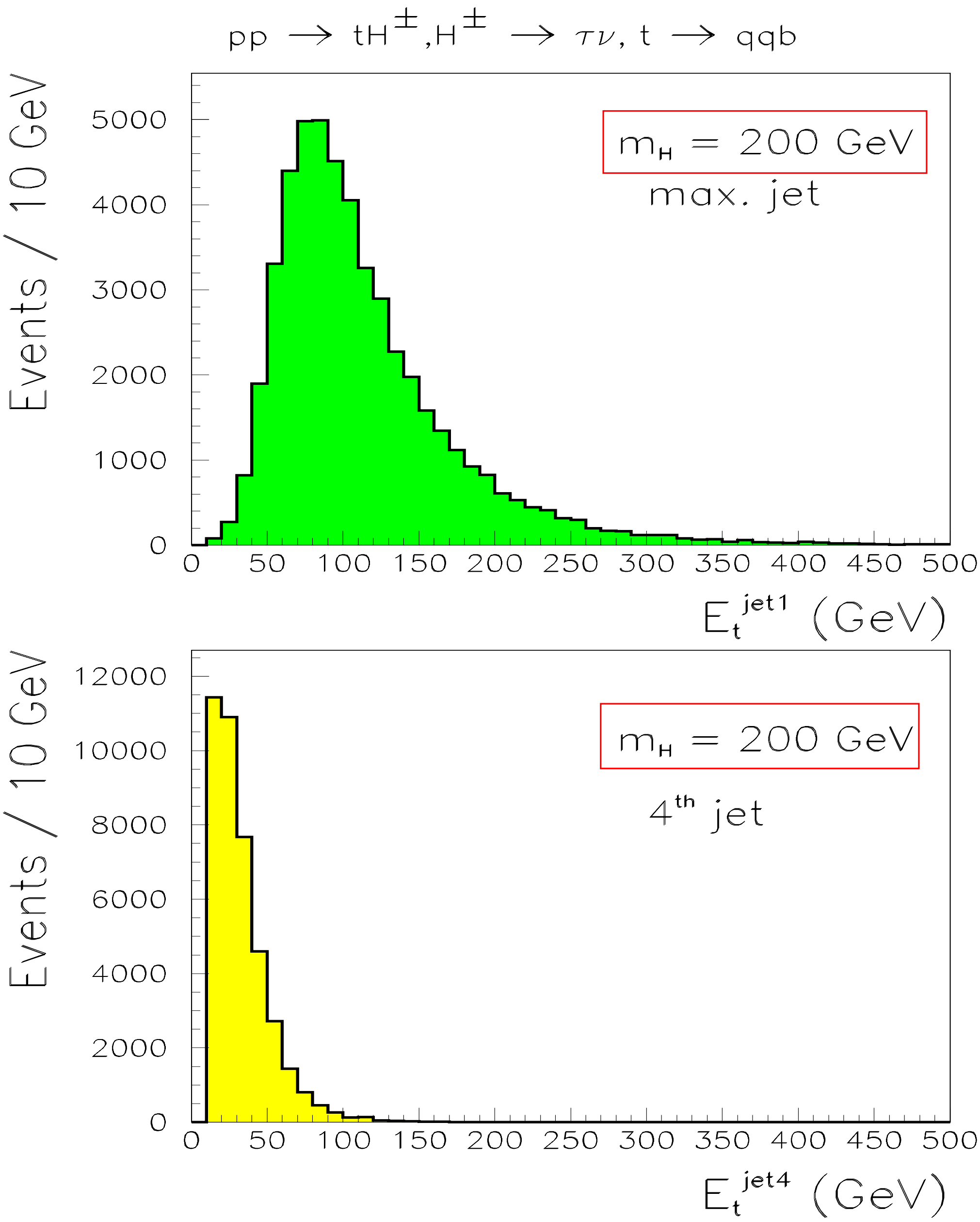
Jets in tH^+, $H^+ \to \tau\nu$, $t \to qqb$ events

Reconstruction with CMSJET



Fraction of events with hardest jet = τ jet for $E_t^{jet} > 100$ GeV: 75 %

Jets in tH$^+$, H$^+$ -> $\tau\nu$, t -> qqb events



Fraction of events with hardest jet = τ jet for E_t^{jet} > 100 GeV: 72 %

Event selection for tH^+, $H^+ \to \tau\nu$, $\tau \to h^+ + X$

1) τ selection:

   jet, $E_t > 100$ GeV, $|\eta| < 2.5$ containing

   one track with $r = p^h / E^{jet} > 0.8$, $\Delta R(\text{jet,track}) < 0.1$

2) $E_t^{miss} > 100$ GeV

3) W and top mass reconstruction from jets with $E_t > 20$ GeV

   minimizing $\chi = (m_{jj} - m_W)^2 + (m_{jjj} - m_{top})^2$

4) W mass cut, $|m_{jj} - m_W| < 15$ GeV

5) top mass cut, $|m_{jjj} - m_{top}| < 20$ GeV

6) Tagging of the jet not assigned to W with $E_t > 30$ GeV, $|\eta| < 2.5$,

   efficiencies from TDR (2 tracks, p_t>1, GeV, σ^{ip}> 2):

   50% for b-jets, 1.3 % for non-b-jets

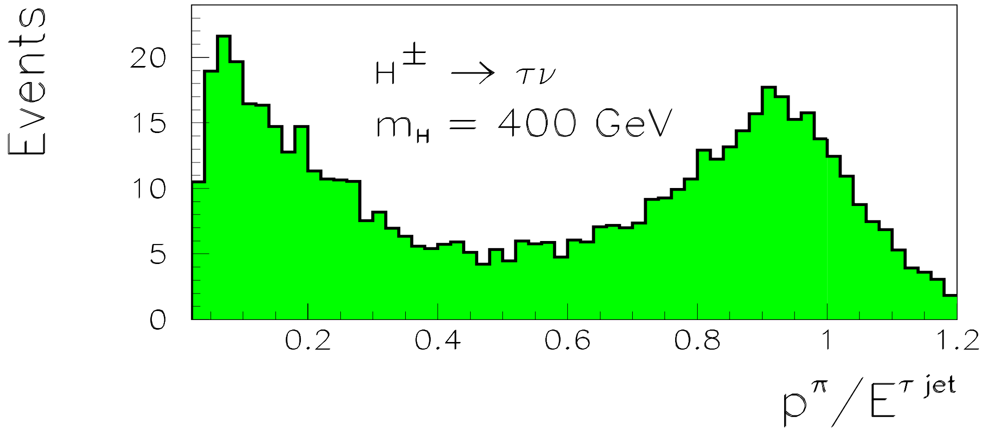
7) Central jet veto, $E_t^{jet} > 40$ GeV

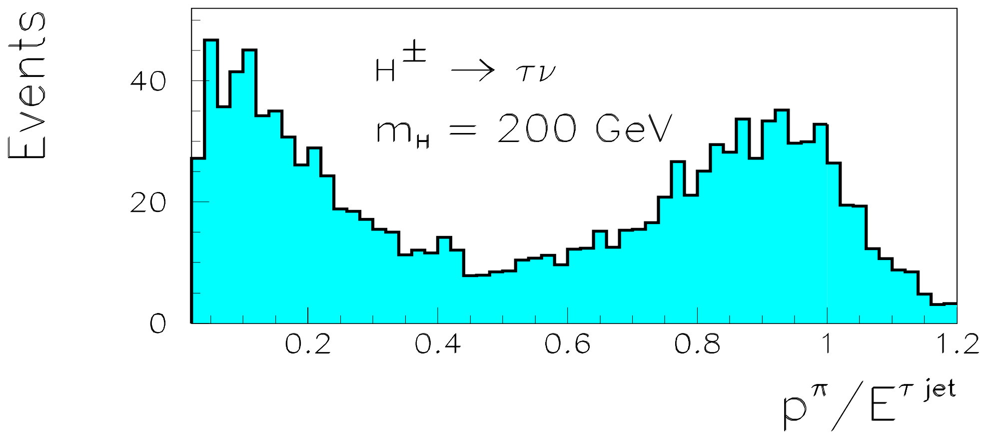
8) Second top veto, $|m_{\tau\nu j} - m_{top}| > 130$ GeV

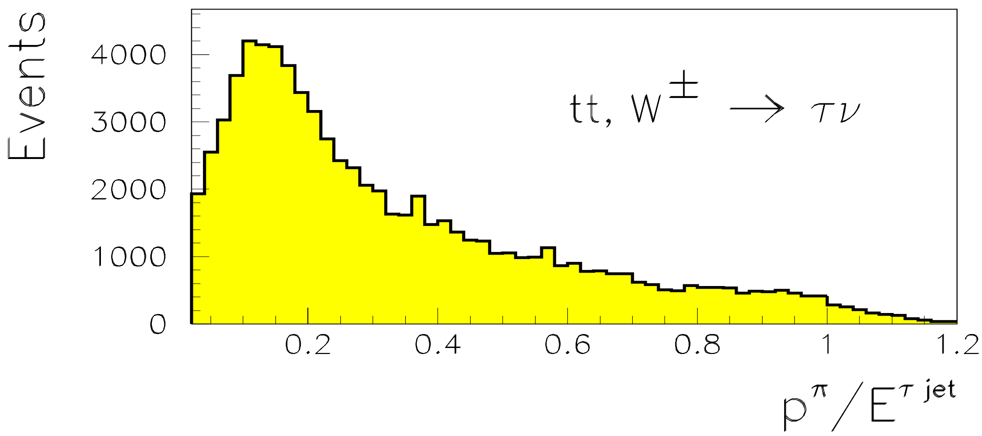
9) transverse mass reconstruction $m_T(\tau \text{ jet}, E_t^{miss})$

τ selection for one prong τ jets

one pion with $r = p^h / E^{jet} > 0.8$ within ΔR(calo jet axis,track) < 0.1

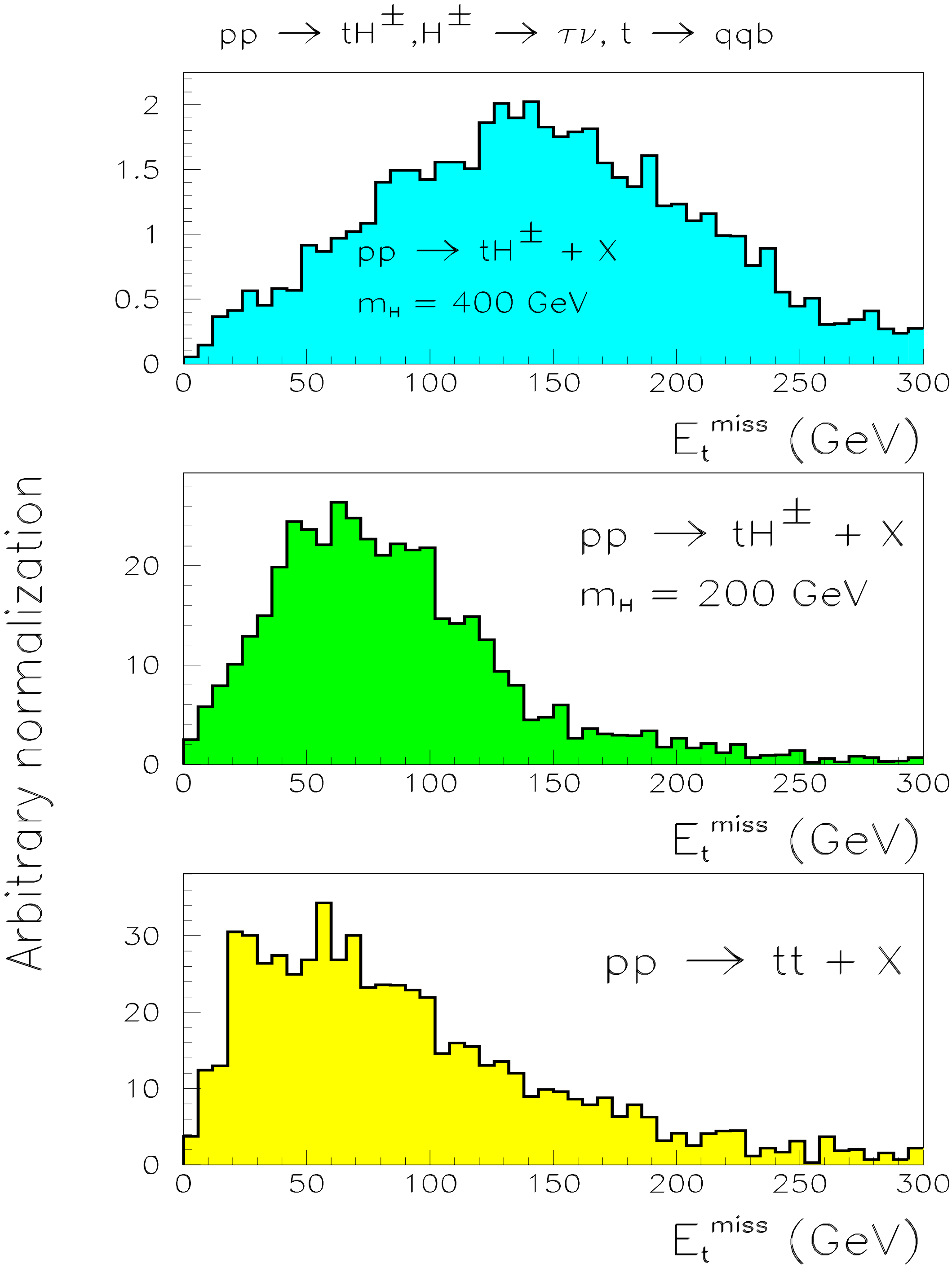






E_t^{miss} in tH^+, $H^+ \to \tau\nu$, $t \to qqb$ events

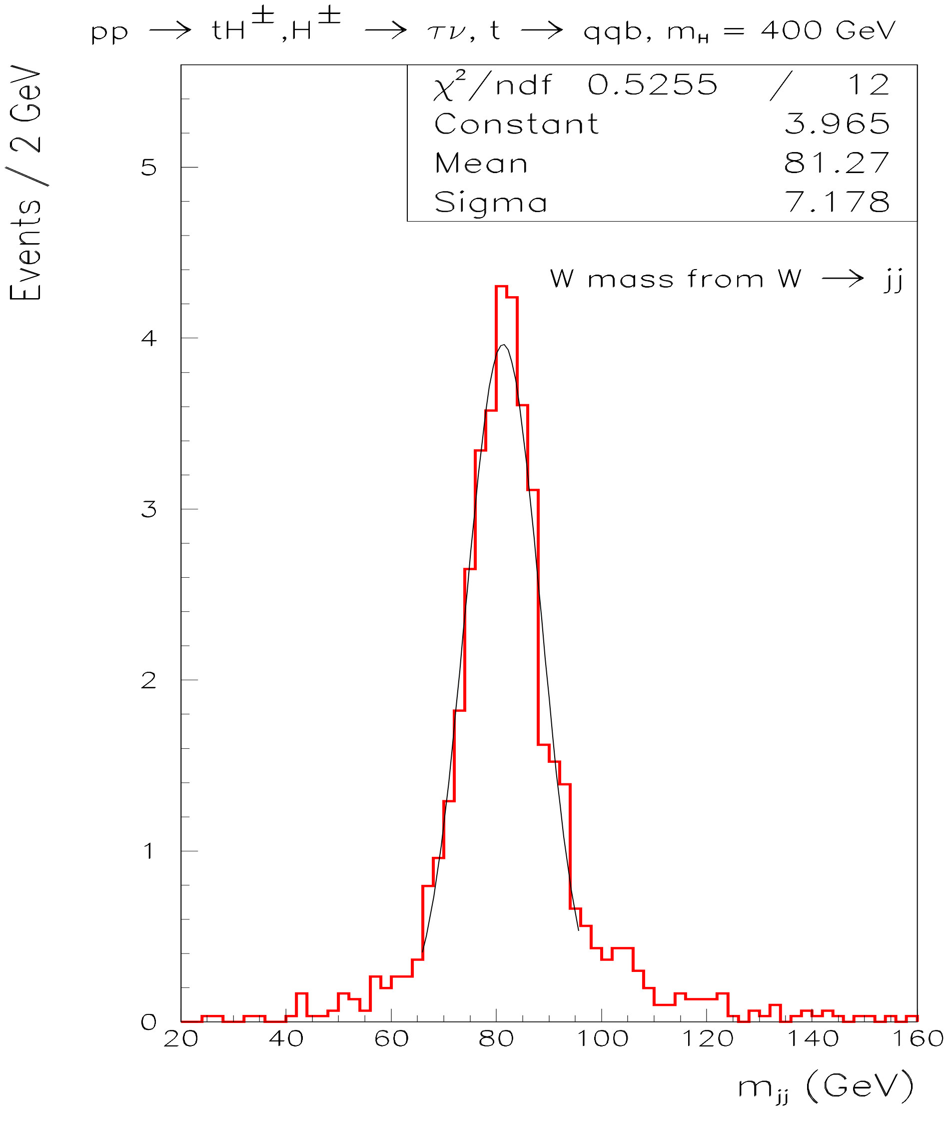
Reconstruction with CMSJET



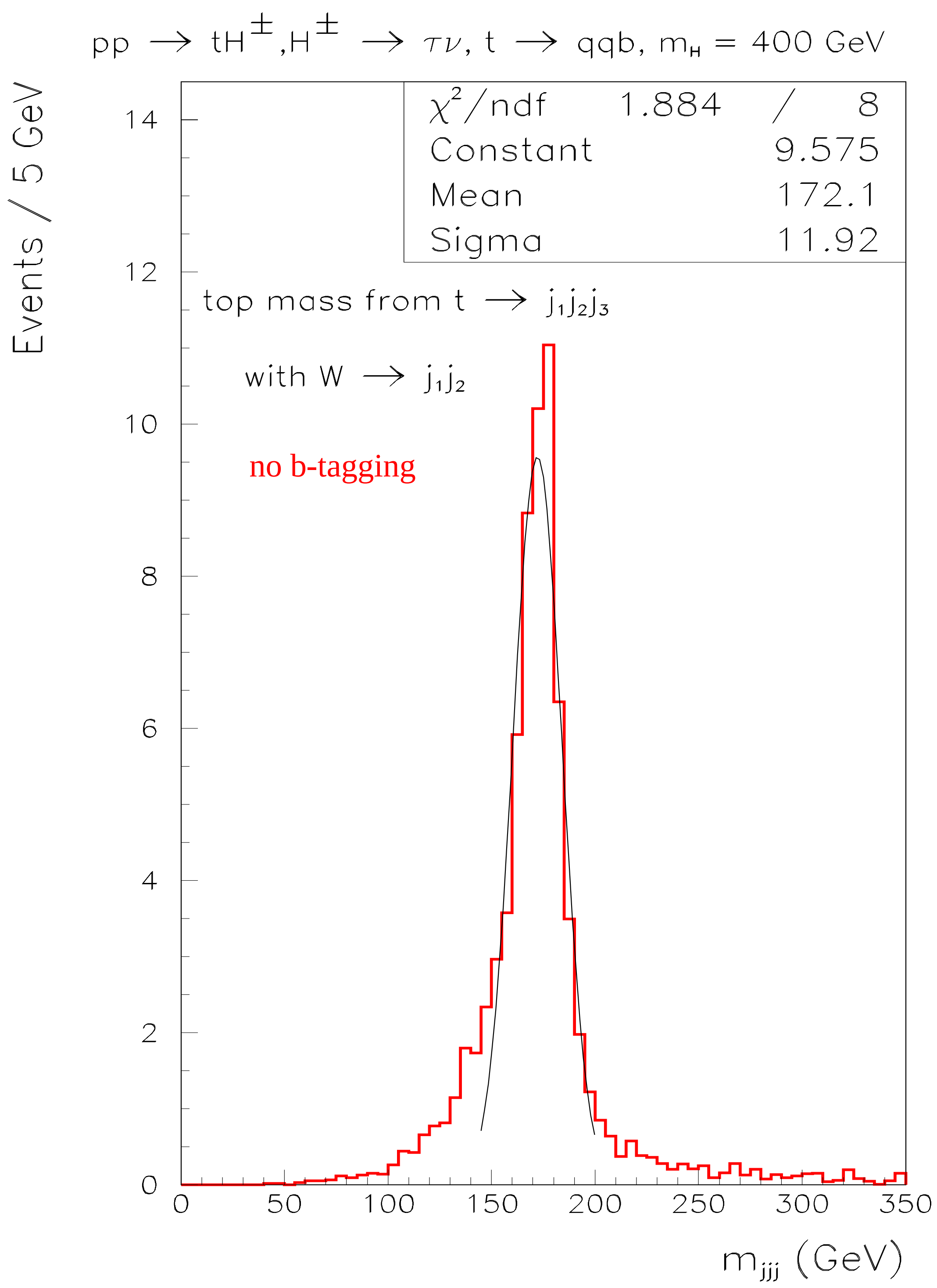
Reconstruction of m_W and m_{top} in gb -> $H^+\bar{t}$

using the jet energy correction from V. Drollinger

1. Selection of events with at least 3 jets, E_t > 20 GeV
2. Reconstruction of m_W and m_{top} from j_1, j_2 , j_3
   minimizing $(m_{jjj} - m_{top})^2 + (m_{jj} - m_W)^2$
3. Tagging of j_3 as a b-jet



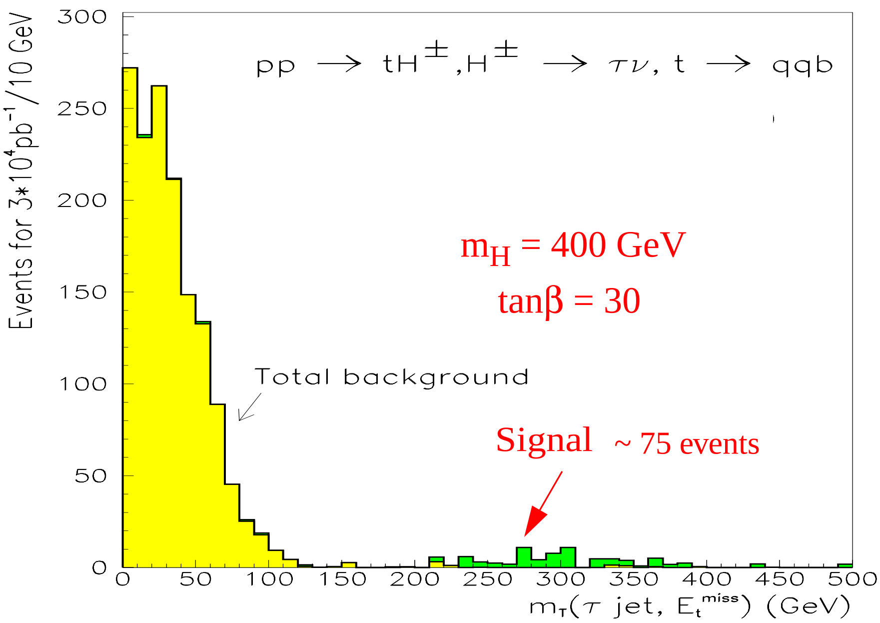
Reconstruction of m_{top} from top -> $j_1j_2j_3$ with W -> j_1j_2

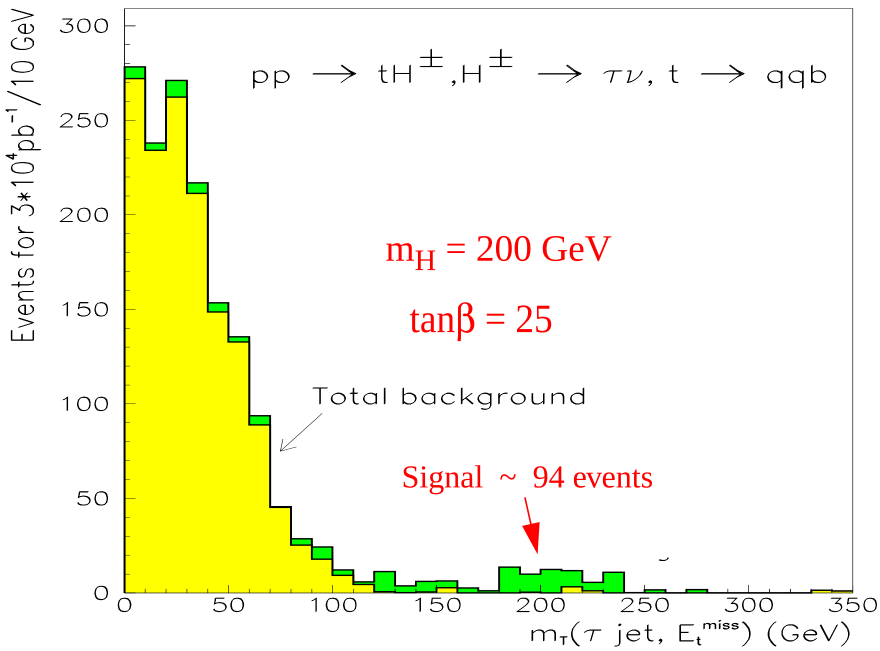


$m_T(\tau \text{ jet}, E_t^{miss})$

signal / background for 10^5 pb^{-1}

τ selection $p^h/p^\tau > 0.8$



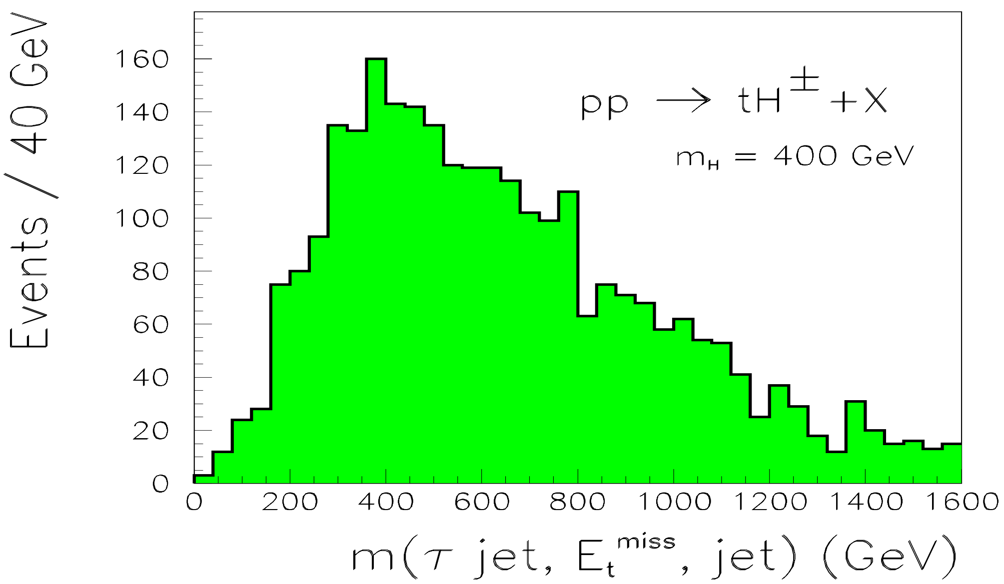


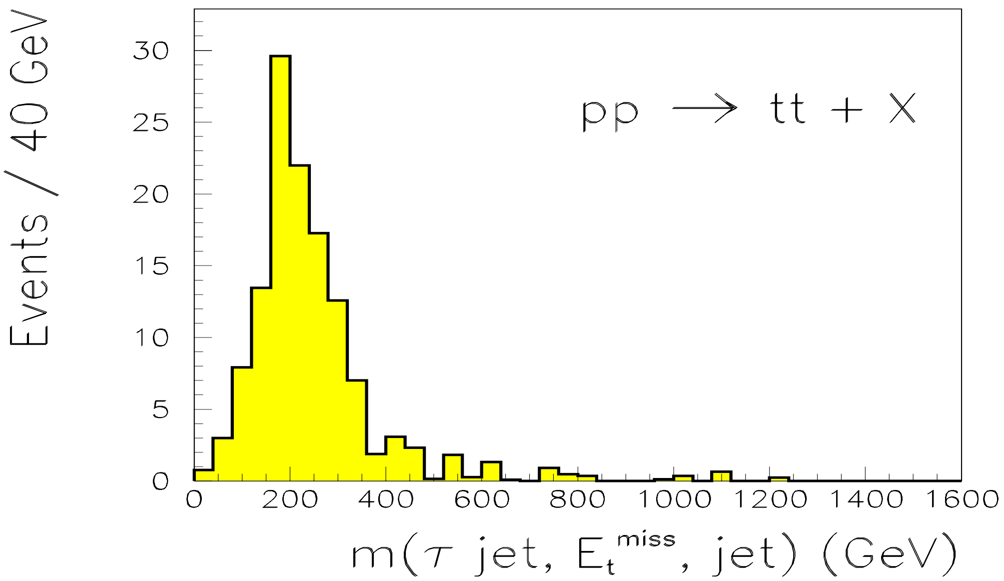
Veto on a second top in $t\bar{t}$ events

Reconstruction of top mass from τ jet, E^{miss} and one remaining jet

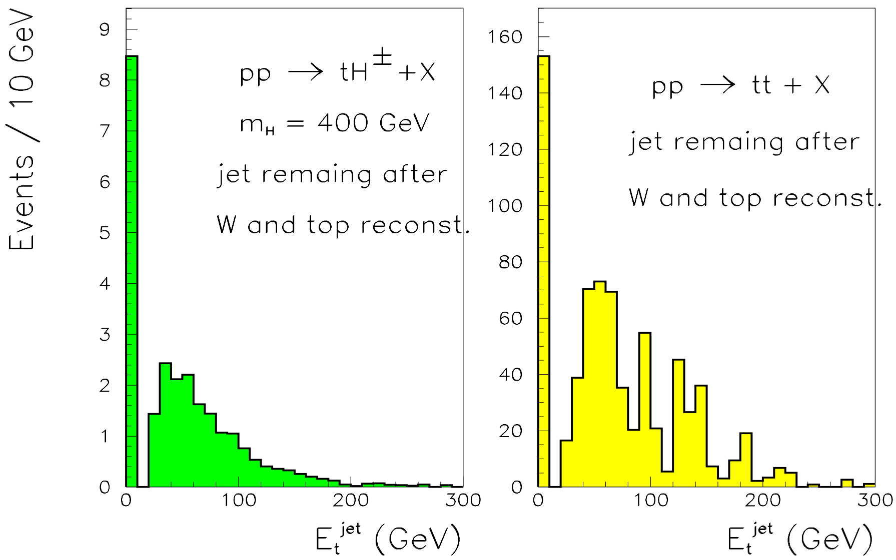
Reconstruction of p_L^{ν} from W mass constraint

Top veto cut with m(τ jet,E^{miss} ,jet) > 300 GeV

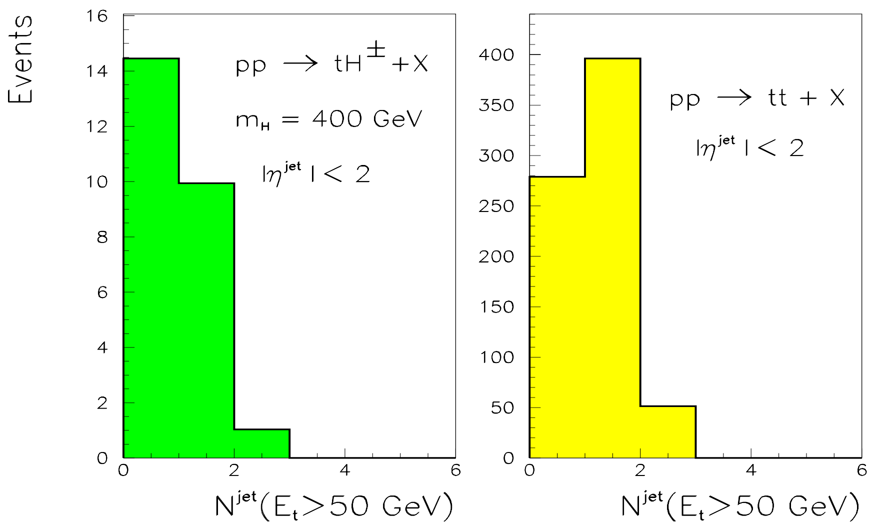




Central jet veto



E_t of the hardest jet after W and top mass reconstruction within (| η |<2)

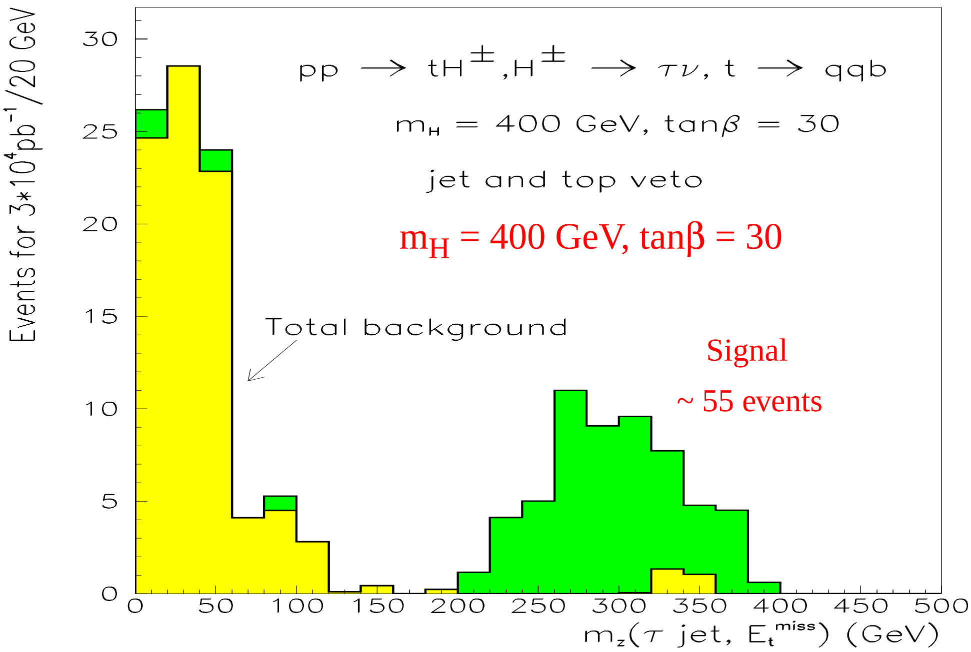


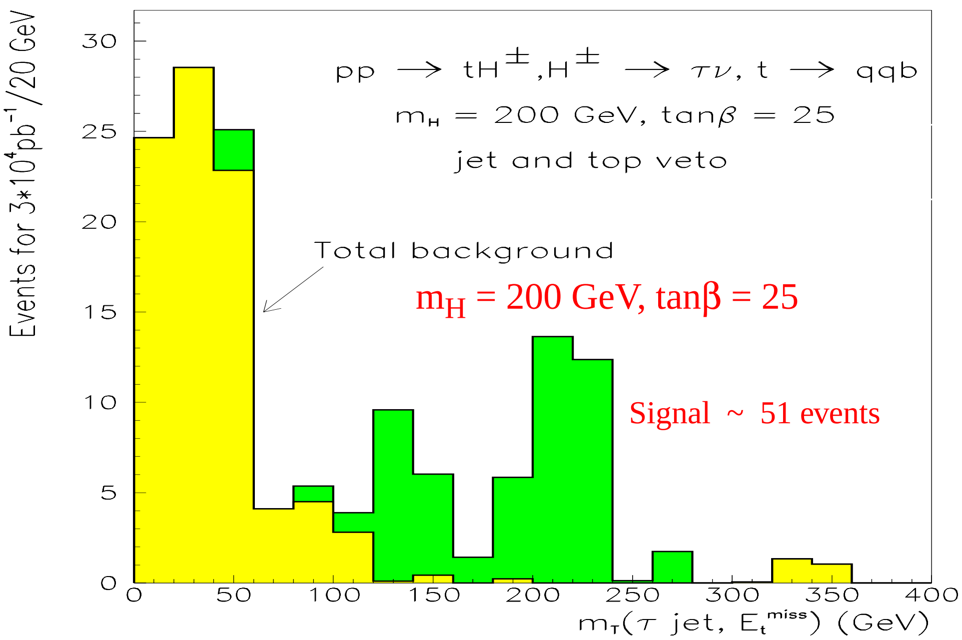
Number of jets E_t > 50 GeV, | η |<2

$m_T(\tau \text{ jet}, E_t^{miss})$, Lt = 100 fb^{-1}

with veto on a central jet, E_t^{jet} > 40 GeV, $|\eta^{jet}|$ <2

and veto on a second top, $| m_{\tau\nu j} - m_{top} |$ > 130 GeV





Events for 10^5 pb^{-1}

	Signal	Background tt, Wtb, W+jet
$m_T(\tau\ \text{jet}, E_t^{miss}) > 100$ GeV		
m_A = 400 GeV, , $\tan\beta$ = 30	68.5	25.6
m_A = 200 GeV, , $\tan\beta$ = 20	41.1	25.6
m_A = 600 GeV, , $\tan\beta$ = 40	33.5	25.6
$m_T(\tau\ \text{jet}, E_t^{miss}) > 200$ GeV		
m_A = 400 GeV, , $\tan\beta$ = 30	61.9	7.8
m_A = 200 GeV, , $\tan\beta$ = 20	12.5	7.8
m_A = 600 GeV, , $\tan\beta$ = 40	31.8	7.8
$m_T(\tau\ \text{jet}, E_t^{miss}) > 100$ GeV, second top and jet veto		
m_A = 400 GeV, , $\tan\beta$ = 30	37.8	4.2
m_A = 200 GeV, , $\tan\beta$ = 20	18.2	4.2
m_A = 600 GeV, , $\tan\beta$ = 40	17.9	4.2

Conclusion

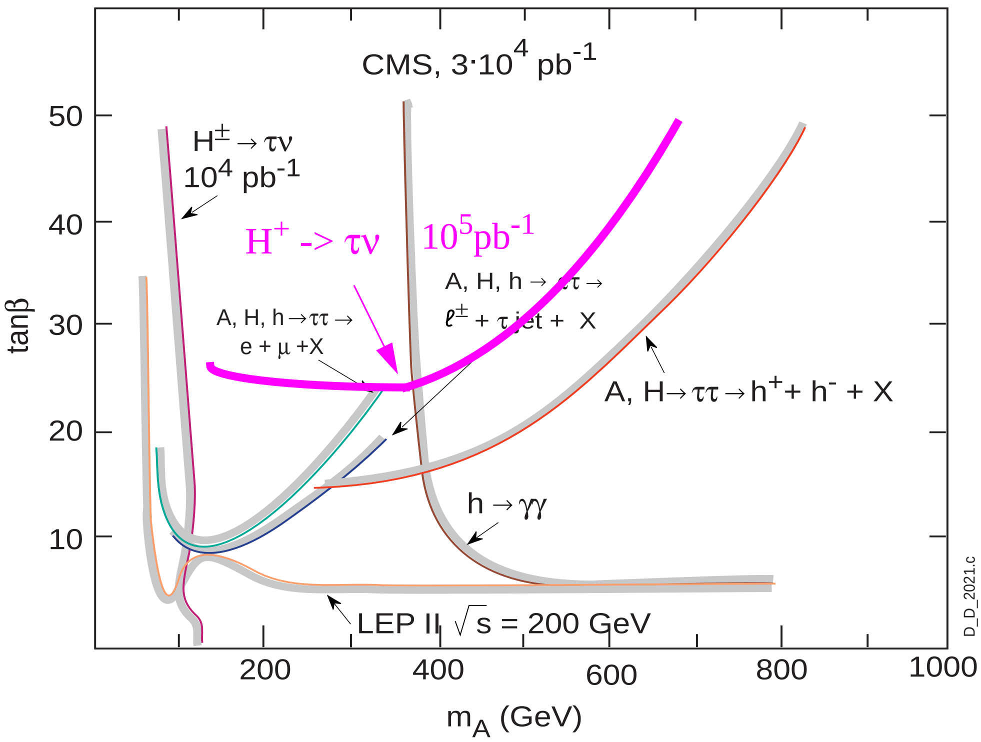
- Preliminary results for pp -> tH^+, H^+ -> $\tau\nu$:

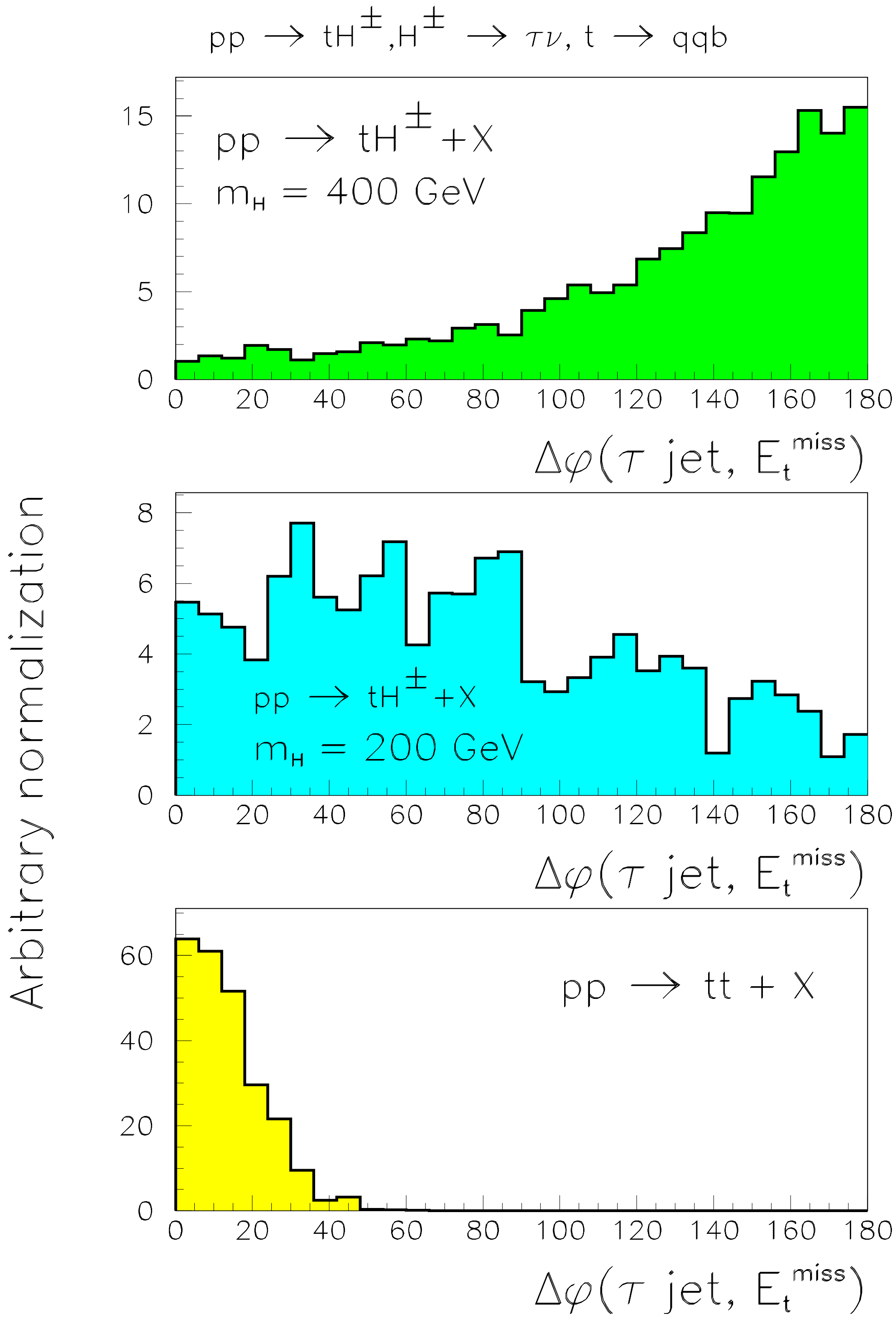
Events for $m_T(\tau \text{ jet}, E_t^{miss}) > 200$ GeV, 10^5 pb^{-1}

Signal, m_A = 400 GeV (m_{H+} = 410 GeV), $\tan\beta$ = 30	39
Background	7.8

(~2.1 events from $t\bar{t}$, ~2.0 from W+jet, ~3.7 from Wtb)

- expected parameter space coverage for 100 fb^{-1}





pp → tH±,H± → τν, t → qqb
pp → tH± +X
m_H = 400 GeV
pp → tH± +X
m_H = 200 GeV
pp → tt + X
Arbitrary normalization
Δφ(τ jet, E_t^miss)
Δφ(τ jet, E_t^miss)
Δφ(τ jet, E_t^miss)

Physics meeting, 10 February, 2000

Trigger requirements for

$gb \rightarrow H^+\bar{t}$; $H^+ \rightarrow \tau^+\nu$, $\bar{t} \rightarrow \bar{b}q\bar{q}$

R. Kinnunen

- Almost background-free signal expected in $m_T(\tau\nu)$

- $m_T(\tau\nu)$ reconstruction usefull only in the purely hadronic channel

- τ polarization provides a large reduction of the $t\bar{t}$ background in the hadronic one prong decay channel $\tau \rightarrow \pi^+ + \nu$

- a purely hadronic trigger with $n_{jet} \leq 4$ ($E_t^{jet} > 20$ GeV) including one hard τ jet ($E_t^{jet} > 100$ GeV) is needed